THE DOUBTFUL FUTURE OF THE PIGMY HOG AND THE HISPID HARE[1]

Part I—A Conservation Report
Pigmy Hog Field Survey, 1977

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(*With a plate and three text-figures*)

INTRODUCTION

Following the dramatic reappearance of the pigmy hog *Sus salvanius* and the hispid hare *Caprolagus hispidus* in March 1971, much interest has been generated in these species. The events leading up to their rediscovery and the subsequent history of the captive animals has been well documented elsewhere (Mallinson 1971; Tessier-Yandell 1971) and it is unnecessary to review it here. The seemingly unlikely close association of the two species is both interesting and pertinent, though the reasons for it are not hard to find since they apparently show a similar distribution and habitat preference, i.e. the 'thatchlands' of north-western Assam. They were both unjustifiably considered extinct by some authorities on the purely negative evidence that stemmed from a common lack of knowledge owing to poor feedback from local sources of information. However, their apparent scarcity is not merely a function of the remoteness of their distribution. The fact that their distribution is limited has been appreciated, as has their scarcity even within the narrow confines of this distribution range and both species deservedly merit Schedule I categorisation in the Indian Wild Life Protection Act (1972). This known scarcity has been attributed to the limited distribution and to habitat destruction though the real species situation and its underlying causative factors have been poorly understood. Hence the 'indeterminate' Category 4 status accorded to both species at the present time by I.U.C.N. Red Data Book.[3]

There are actually relatively few documented accounts of either pigmy hog or hispid hare in the intervening period between the 1971 reappearance and their original published descriptions in the mid-19th century. This lack of data is not altogether surprising in view of their small size and secretive nature, their dense and observationally-unsuitable habitat and their (scientifically) remote distribution. What little knowledge we have is therefore based primarily 'shikar' accounts but would indicate both species always had a somewhat restricted distribution within recent historical times. Thus over the last century or so, hispid hare had been recorded at intervals along the Southern Himalayan foothill belt that stretches from northern Uttar Pradesh in the West, through Nepal, Sikkim, North Bengal, southern Bhutan to north-western Assam. As far as we know pigmy hog had a similar dis-

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[3] As a result of the findings of this report the I.U.C.N. Red Data Book categorisation for this species has now been changed from Category 4 (indeterminate) to Category 1 (endangered).

tribution though there are no accounts available for the species as far west as Uttar Pradesh. Within the last few decades both species have been declining steadily and all post-1971 records (with one exception) appertain to north-western Assam, though the distribution of both species may stretch into east North Bengal and southern Bhutan where the thatch-scrub jungle continues into these areas. (Fig. 1).

maputra river before or in Arunachal Pradesh or north-western Assam. Both latter districts are high rainfall areas with a preponderance of evergreen forest and little thatchland in the forest belt.

In the interim the present-day known distribution of both species is exclusively the forest belt of north-western Assam. It is quite likely therefore that both species are now unique to this vicinity and anyway should be

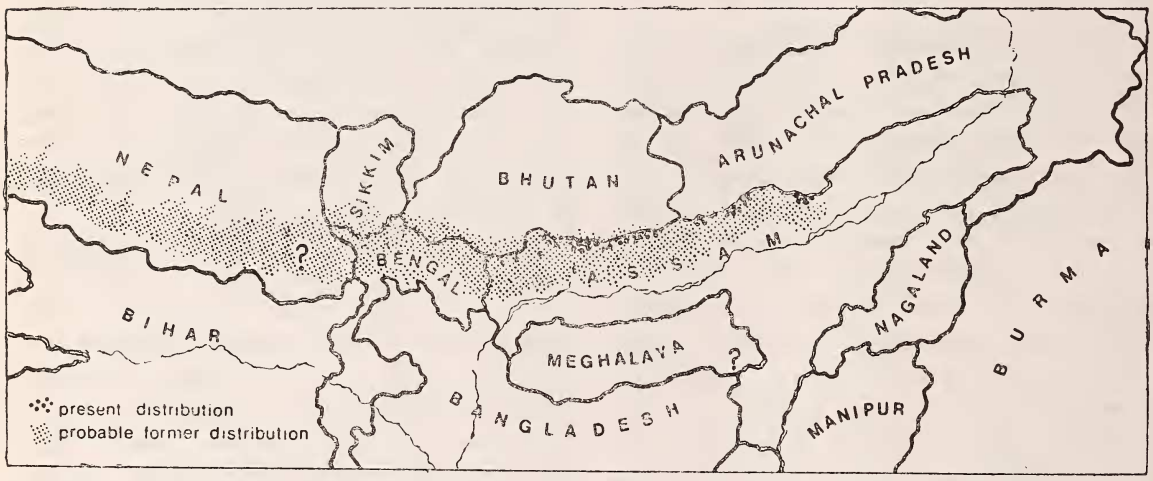


Fig. 1. Present and Former distribution of Pigmy Hog (*Sus salvanius*).

Eye witness accounts support this steady decline with reports of observations over a much larger area of Assam 15 years ago or more. In 1964 a U.S. expedition from the Hormel Institute spent four weeks looking unsuccessfully for pigmy hog in Nepal. A recent and apparently reliable report of pigmy hog in Cachar in south-eastern Meghalaya (G. S. Chaudhury, pers. comm.) is most interesting for it implies a much extended former distribution for this species owing to the necessity for circumnavigation of the Brahmaputra river barrier to the south. However, neither species has been reliably recorded south of the Brah-

regarded as such until reports from other areas are positively confirmed or negated. By the very nature of the habitat and of the species it is not possible to be categorical about distribution, but even if other populations do materialise, it is very likely that the population/habitat pressures that are so strongly evident in Assam (but which are not unique to this area) would apply equally strongly elsewhere.

The story is a familiar one, for which progressive human settlement is largely responsible by making further and yet further inroads into former natural habitat. Whilst

some may feel this is deplorable, it is of course objectively irreversible and practical conservation measures must be directed at the protection and salvage of the small remaining habitat areas. As far as pigmy hog and hispid hare are concerned, the situation is immeasurably worsened by the degradation of the small remaining thatch-scrub areas for the exploitation of forest resources and the tradition of burning during the dry season.

Since 1971, there has been considerable expense and effort engendered in efforts towards their conservation, particularly of pigmy hog. However, this effort has been primarily directed towards the acquisition of specimens for captive husbandry and no action has been taken towards the underlying causative factors in the decline of the wild populations. That the wild populations are declining is in no doubt as the known distribution and remaining habitat dwindles and becomes increasingly discontinuous and increasingly under pressure.

Moreover, the captive breeding projects for these species have not been an unqualified success. Hispid hare are probably 'non-starters' in captivity anyway as the few specimens that have been caught have amply demonstrated by succumbing within remarkably short time after capture. Hares are notoriously difficult to maintain in captivity owing to their temperament and disease-susceptibility, and considerable expertise is required even to maintain them without breeding. By contrast, the pigmy hog captive breeding effort has shown promising indications of its potential as a safeguard to the species survival, though in retrospect this potential has been far from realised. Despite an apparent ease of breeding and the successful long-term maintenance of a few individuals, mortality has remained unjustifiably high owing to crude methods of capture, the nervous disposition of the newly caught animals themselves and a lack of expertise resulting in poor husbandry practices. However, the captive stocks that remain are still potentially viable even if much depleted, and they have provided much valuable information on reproductive and behavioural biology. Perhaps equally important is that the considerable efforts that have been made with regard to captive pigmy hogs have also generated considerable public and official interest and awareness in this species and this could be of great significance to future policy regarding their conservation.

However, though captive breeding efforts are meritorius in that they are conservation-oriented, they ignore the basic and much more significant and important aspects of the species' predicament, i.e. the fundamental problems of the wild situation. Captive breeding however successful, does not represent a solution to the endangered species problem, even though it is a very valuable tool that may provide a hedge against extinction, a study source and (ideally) a source for reintroduction should that become necessary. Thus the continued efforts of research and breeding captive pigmy hogs must go hand in hand with efforts at reversing the current trends of the continuing degradation of wild habitat and wild populations. It is hoped that this study will provide some information as to the causative and fundamental problems faced by the wild stocks and provide a framework for their conservation. Problems faced by the wild populations are profound but not irreversible provided they are looked at objectively and any action that may be generated is not merely legislation on paper.

The survey in which this report is based was undertaken as a result of the realisation that an objective analysis of population trends and pressures was required before any action

was contemplated. It was also intended to investigate the biology of these species in the field and the survey was arranged to coincide with the period following the annual burning of the thatchlands where these animals were known to occur. This was to facilitate behaviour study as it is during this period that most observations of pigmy hog have occurred as the thatch grass is naturally at its shortest following burning. The survey was of admittedly short duration, i.e. March-June 1977, but in the event has proved to encompass the most critical period for the biology and conservation of these species. Finally it is necessary to add (by way of excuse) that the survey was not as fully comprehensive as would have been desirable owing to the author's movements being limited by time, by foreigner's permit requirements, poor communication facilities and for the most part, poor weather conditions. Having said that, the pattern that emerges is till startlingly apparent even though it was not possible to visit all the probable or known areas of distribution.

The Reserve Forest Belt

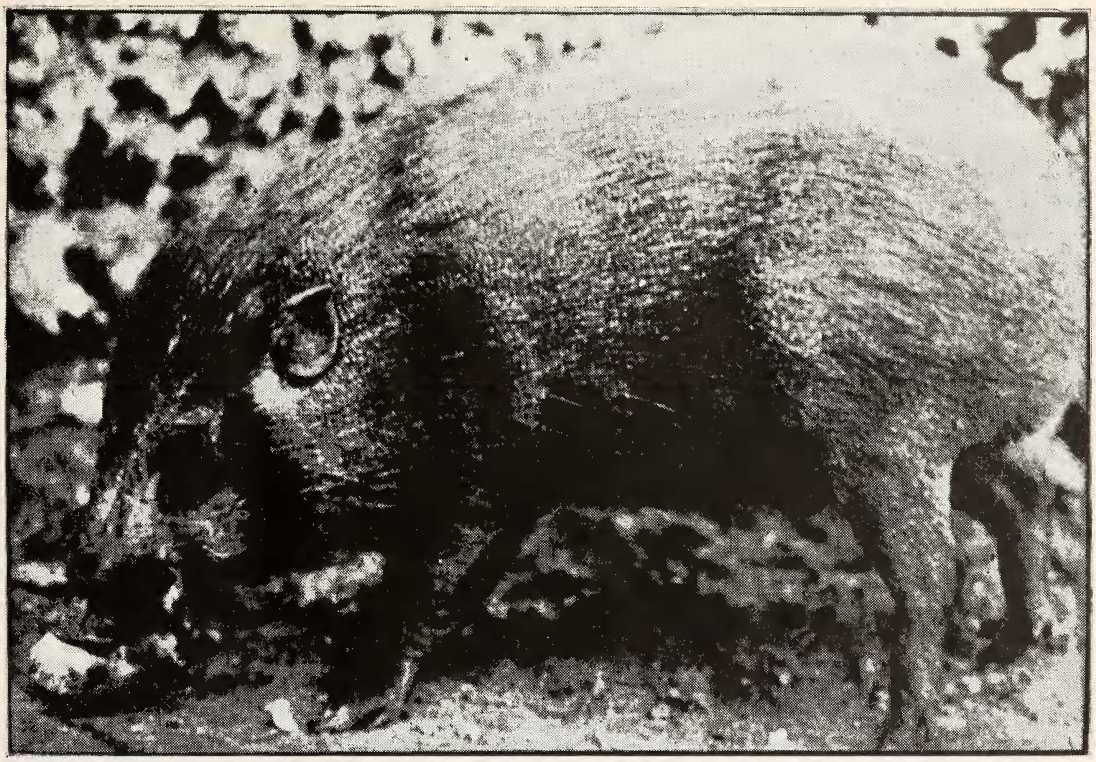
Before analysing the results obtained it is important to establish the present context with respect to the wild situation. Thus there is comparatively little 'wilderness' left in Assam owing to the continuous and progressive settlement and cultivation of an expanding and immigrating people. Land is under tremendous pressure and the rate of transformation of former habitat has been dramatic in the past few decades. This is a continuing process and human population increases have been accelerating disproportionally owing to immigration, particularly of Nepalese peoples, but also to a lesser extent some Bengali and other peoples. This process has resulted in the replacement of practically all natural habitat up to (and frequently beyond) declared forest boundaries.

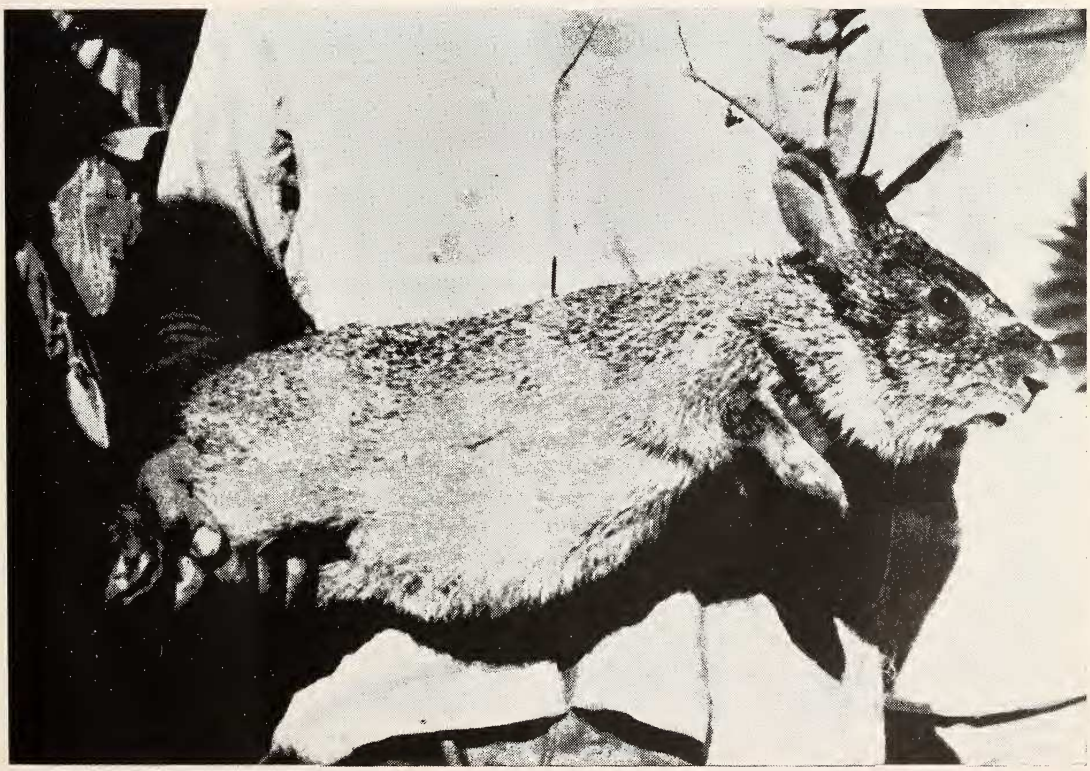
The north-western forest belt, where these species occur is a semi-continuous series of forest and thatchland areas that run from east North Bengal to Upper Assam. Immediately to the north the primary forest (the so called 'bhabar' forest) continues into the foothills of Bhutan and Arunachal Pradesh. The eastern side a higher rainfall area and is comprised mainly of evergreen forest with little or no thatch-scrub jungle which accounts for the likely absence of either species to the east of North Lakhimpur.

This forest belt is intersected by tributaries of the Brahmaputra River and is divided into Reserve Forests, Unclassed State Forests and two wildlife sanctuaries (Manas and Sonai-Rupa). Neither Reserve Forests or Unclassed State Forests are regarded as wildlife areas in as much as legislation for wildlife protection is governed only by the individual species categorisation according to the Indian Wild Life Protection Act and regulations governing access to persons entering the Reserve Forests. Essentially Reserve Forests are geared towards the commercial exploitation of the forests by the Forestry Department, i.e. Reserve Forests have an afforestation or reafforestation programme. Thus primary forest is felled for timber extraction and thatchland areas are afforested with commercial species plantations.

Most of the thatchland areas are also subject to annual harvesting for thatch (thatch-mahal) under permits issued by the Forest Department as thatch is a very important building material which is used for roofing for the vast majority of dwellings in Assam. Some Reserve Forests also have grazing concessions and some have sand and stone mahals.

The Unclassed State Forests which are interspresed between the Reserve Forests, do not





(Photos: *Author*)
(Captions overleaf)

Above: Adult male pigmy hog photographed on a tea estate in Assam. This animal weighed approximately 8 kg and stood about 11 inches at the shoulder. n.b. marked streamlining for a very dense habitat. *Below*: Adult female hispid hare caught accidenly in Barnadi Reserve Forest in late April 1977, whilst trapping for pigmy hogs under permit for the attachment of radio harnesses. The animal was immediately released after being photographed. n.b. heavily pregnant.

have an afforestation programme and are not actively managed by the Forest Department, and most of them are being progressively encroached upon and many are unlikely to survive as forest areas. The degree of encroachment varies considerably from negligible at the present time to almost complete encroachment. Many Reserve Forests are also subject to encroachment to a greater or lesser degree. The majority of settlement in Unclassed State Forests and Reserve Forests is actually encroachment but there are official settlements particularly in Unclassed State Forests. In some places little or no action has been taken against illegal settlement, but elsewhere successful eviction proceedings have been instigated though sometimes with difficulty owing to the claims of squatter rights.

These processes have a particularly serious effect on the thatchland and scrub jungles which are highly susceptible to human disturbance particularly by dry-season burning. This habitat (unlike the true forests) has now become discontinuous and forms a series of discrete and highly vulnerable units within declared forest boundaries. Moreover these thatchland areas tend to be along the southern edge of the forest boundaries and are therefore often in particularly close proximity to human habitation and few of these areas too remote to be easily accessible. There are actually two classes of thatch savannah, i.e. highland and lowland savannahs. The latter is subject to heavy waterlogging or even prolonged inundation during the monsoon. In the north these areas are typically the 'char' grasslands along river boundaries which probably never support these animals. The better-drained highland savannah basically comprises typical thatch-scrub jungle (when left unburnt) which is the habitat of these species.

The Barnadi Reserve Forest

The main study area was the Barnadi Reserve Forest in the Rajagarh area of Mangaldai in Darrang District. This locality was an obvious choice as it was from this region that both species originally reappeared and has been the source of the original (and nearly all subsequent) captive stock. Together with the Manas Sanctuary it is also the only area from which these species were widely known to occur.

This area was therefore thoroughly surveyed as to distribution of the species, habitat preferences, behaviour and animal movements. The report on many of the aspects of the study are published elsewhere (Oliver 1977) and I have only touched upon behaviour where this is directly relevant to the conservation issues. For example it is very easy to prove or negate the species activity in any particular area by screening for behavioural indicators such as the distinctive forage marks of pigmy hog or the thatch cuttings/faecal deposits of hispid hare. Therefore a careful examination of the whole area together with the questioning of forest officials, local villagers and shikaris easily establishes the population distribution and habitat preference. A critical analysis of an area such as the Barnadi Reserve Forest, manifestly demonstrates the reasons for the continued decline of the wild populations.

Barnadi lies about four miles north of Attareckhat and one mile north of Rajagarh village. It is bordered in the west side by the Bornadi River and to the east by the Nalipara Nadi. The northern boundary is the common international border with Bhutan and the primary forest belt is continuous with that of the Bhutan foothills. The Bornadi river is a com-

mon boundary with the Darranga Reserve Forest to the west (where pigmy hogs have also been recorded) but to the east there is an Unclassed State Forest which is extensively cultivated by encroachment and some official settlement. All southern boundaries verge onto cultivation areas and though much of the perimeter is fenced, this fencing is in poor repair and is completely ineffective in restricting unofficial human and domestic animal movements. There is therefore free access to the reserve areas along the south-west, south and south-east boundaries. The reserve area was formerly entirely surrounded on the southern sides by mixed highgrass scrub jungle, but with progressive settlement over the last 10-15 years these areas are now purely rice-paddy cultivation and village settlements. The total reserve area is approximately 24.6 sq. kilometres of which approximately 8 sq. kilometres (20%) along most of the western side is extensively encroached. Approximately 7 sq. kilometres is mixed deciduous and evergreen forests and thus is largely undisturbed.

The central and south-western section is an extensive and continuous thatchland belt and afforestation area with plantations of simul, gomari, bonsom and some (exotic) teak and Eucalyptus. This thatchland is subject to a thatch-mahal and this thatch concession covers the entire area. The thatch is officially harvested between 1st November and 30th April by a contractor (permit holder) or private individuals with contractors permission. There are no grazing concessions, but in fact the thatch area is extensively and illegally grazed daily by about 250 head of cattle and a few domestic buffaloes and sheep. The whole thatch area is approximately 12.6 sq. kilometres (i.e. about 50% of the total Reserve Forest).

Nearly all the thatchland is burnt annually during the dry season. This burning is primarily 'accidental' by local people as opposed to 'controlled' by forest officials. The extent of burning varies year by year as it is illegal and uncontrolled, though there are some attempts at control by thatch cutting and burning 'firelines'. The accidental burning is essentially undertaken by 'miscreants', i.e. by carelessness (e.g. herdsmen cooking or smoking in the forest) or the deliberate firing by villagers to improve grazing and thatch yield. The uncontrolled burning in the height of the dry season (late February to early April) is more harmful to plantations than earlier controlled burning when the grass is not tinder-dry. The forest department takes on extra staff as 'firewatchers' in an attempt to control burning during this period, though burning is difficult to prevent and very difficult to control at this time, and to judge from the acreage burnt in 1977 these precautions are completely ineffective. Deliberate or accidental burning by miscreants is greatly facilitated by the ease of access to the forest by the long perimeter between the thatch area and the surrounding cultivated land, i.e. about 10 kilometres.

This burning has a catastrophic effect on the hispid hare and pigmy hog population and the fauna and flora of this thatchland ecosystem in general. There is a profound difference between the rich and diverse biological complex of the unburnt mixed high thatch-scrub biotope and the relatively simple uniformity of regrown burnt thatchland. The difference is clearly a function of the varying species susceptibility to the fire hazard and the ecological instability caused by annual burning. Fire is highly selective and generally speaking only well established trees and plants with well developed root systems are likely to survive. Firing completely destroys all ground cover (and therefore also most food supplies) in the post-burning period prior to the 'chota' (small)

rains which usually occur in April. Plants with well developed root systems and rapid vegetative growth can exploit this situation and thus burnt habitat is characterised by poor diversity but extensive and rapid growth of certain species (e.g. in Barnadi, *Saccharum spontaneum, Phragmites karka,* (both thatch species), *Eupatorium ordoratum, Lea robusta* and *Salvia* sp.) Recolonisation by other plant species naturally depends on their reproductive potential and/or seed and spore dispersal mechanisms. Similarly faunal recolonisation depends on such factors as particular species mobility (thus birds can recolonise quickly), reproductive potential and the local availability of unburnt habitat or (dubiously) alternative temporary fire-displacement habitat.

It is important to acknowledge that not all typically thatch-scrub jungle species are affected to the same degree. Animals that migrate during the dry season avoid the problems of food and water supplies and it has been argued that grazing ungulates may even benefit by dry season burning with improvement of fodder. Other species avoid the problems of dry season survival by aestivation (e.g. reptiles and some insects) or life-history cyclicity (many invertebrates) may also be less seriously affected, though this would clearly depend on the behaviour or mechanisms associated with this torpor phase. It is equally clear that species such as pigmy hog and hispid hare (which we can positively demonstrate remain resident and active in the thatch-scrub during the dry season) must be very seriously affected by burning through the loss of their habitat. It is immaterial that cover is only lost for a relatively short period (two to three months prior to regrowth of vegetation) as there is no suitable alternative habitat and anyway the habitat is seriously modified by the 'selective effects' of burning. Furthermore, it is evident (and amply demonstrated by field analysis) that thatchland areas take several years to fully recover from the effect of burning (one of the reasons for deliberate annual burning is to prevent 'good' thatchland from reverting back to mixed thatch-scrub jungle). Thus annual burning seriously modifies ecosystem composition as long as it is maintained and even a single chance fire can be reasonably expected to show its effects for at least a few years owing to the differing fire resistance of species and other factors already outlined.

The distribution patterns of hispid hare and pigmy hog in Barnadi Reserve Forest manifestly demonstrates these arguments. The burning in late February/early March 1977 was severe in its extent and approximately 80% (i.e. 10 sq. kilometres) of the thatch area was burnt. The population distribution was monitored at regular intervals between late March to early June and remained resident and constant during this period, i.e. entirely restricted to the larger areas of remaining unburnt habitat as shown in Fig. 2.

This pattern of distribution is extremely significant to the conservation of both species and from it we can extrapolate several important facts:—

(I) Both species are found only in unburnt thatch-scrub jungle at this time of year.

There is actually no other suitable habitat with dense cover available in this vicinity. Burnt thatchland offers absolutely no cover and a dearth of foodstuffs in the post-burning period. They have never been reliably recorded from primary forest except in areas immediately adjacent to unburnt habitat, i.e. foraging excursions, or consequent to forced movement of animals displaced by burning. There is actually very little ground cover in the typical primary forest of this region.

(II) Unlike many of the larger indigenous mammals, these species do not migrate but are *resident* in this type of habitat during the dry season.

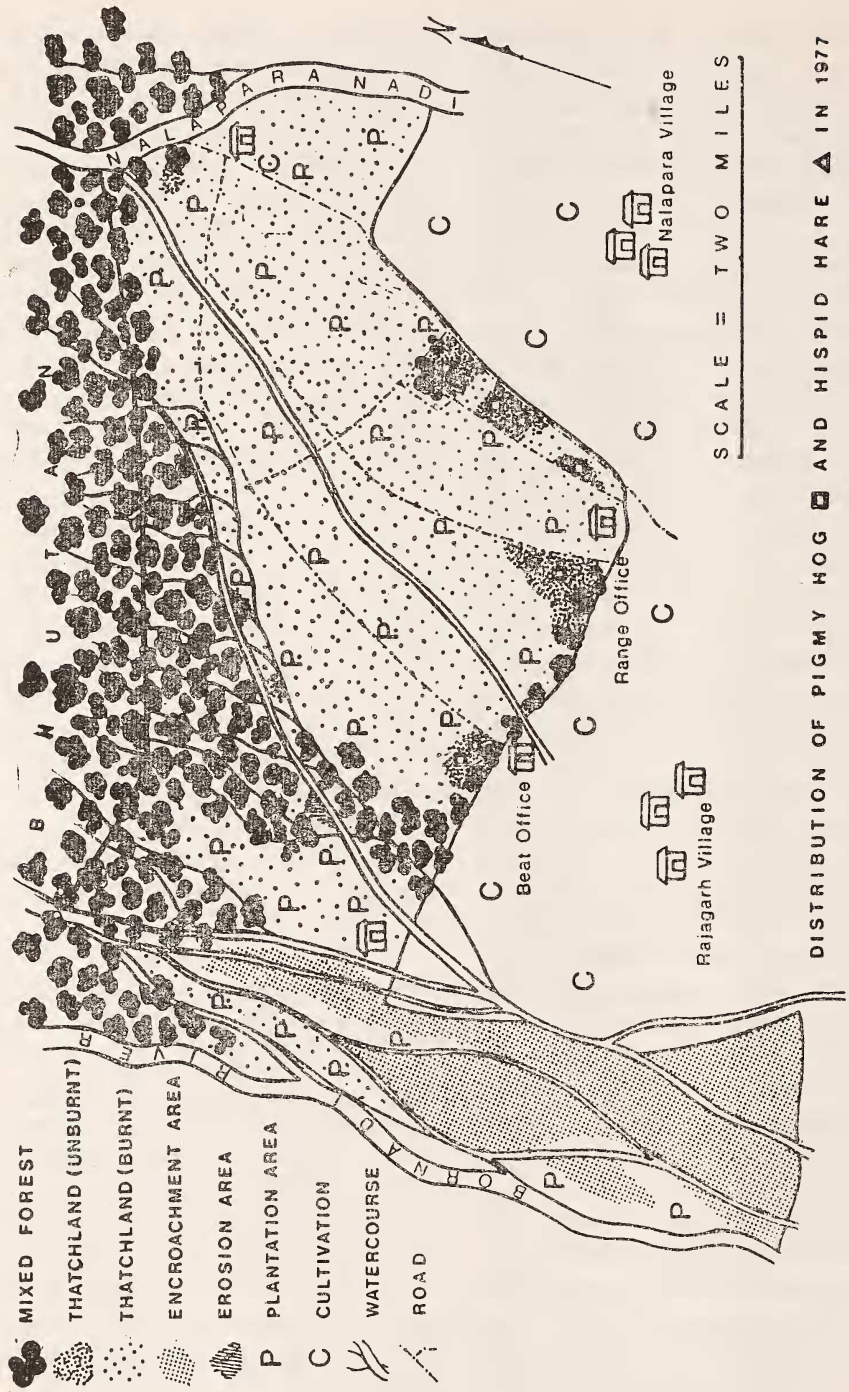


Fig. 2. The Barnadi Reserve Forest was the main study area. Distribution of pigmy hog and hispid hare in 1977.

This is evident as they are found throughout the dry season in suitable unburnt habitat. All observation of these species movements during the day season are directly consequent of displacement from their former habitat by burning, e.g. pigmy hog etc. most frequently seen (and caught) after burning when they are forced out of dense thatch into surrounding cultivation areas seeking cover. Indeed, the original captures in the Attareekhat Tea Estate in March 1971 was consequent of an extensive fire in the thatch-land in the Rajargarh area (Tessier-Yandell 1971). Similarly, pigmy hogs are observed on Budlapara Tea Estate to the south-east of Barnadi every year immediately after burning (D. K. Mukherjee, pers. comm.).

(III) Despite the lack of suitable habitat elsewhere, animals forced to move through habitat destruction by burning, cannot accumulate in the remaining suitable unburnt habitat.

Because burning is so extensive, suitable unburnt habitat is at a premium. The ecological equilibrium of habitat supporting an existing population, cannot support additional animals, because resources are at their lowest during the dry season. Moreover, the socio-territorial behaviour of resident conspecifics would preclude this possibility. The fact that they cannot accumulate is evident by their appearance in unsuitable habitat elsewhere as already outlined.

(IV) The (maximum) resident population of Barnadi during the dry season is therefore roughly proportional to the amount of habitat that is not burnt (see also VI).

(V) The animals displaced by burning and forced into moving to unsuitable alternative habitat can reasonably be expected to suffer a very high percentage mortality.

Through the mere unsuitability of alternative cover (e.g. tea estates which provide cover but poor food supplies, owing to constant insecticidal and herbicidal spraying and are also much disturbed by plantation employees), and direct hunting pressure of animals that are known to be killed in the surrounding paddy cultivation areas and tea estates at this time of year. In Barnadi thatch growth is relatively slow and the intervening period to regrowth of vegetation may be as much as two or even three months. The habitat distortion consequent of burning severely reduces the quality of regrown habitat and this, together with the other factors may result in the complete loss of a displaced population. Burning that is very severe in extent could therefore easily result in the extermination of an entire population in any given area.

(VI) The extreme vulnerability of the small pockets of remaining unburnt habitat further exacerbates a precarious situation resulting in the loss of part of the small remaining population in unburnt areas.

These areas are isolated in the post-burning period and in Barnadi are subject to very considerable human and domestic animal disturbance, i.e. these areas are the only source of thatch for cattle fodder and the only source of thatch, firewood and forest vegetables for local villagers in the immediate post-burning period and are much disturbed as a consequence. Similarly these are the only areas where game is to found and all hunting is concentrated on them, moreover game is very easily killed by driving it out of cover into the surrounding open areas.

As has been stated, approximately 80% of the total thatch area was burnt in 1977. Pigmy hog occur in isolated patches of unburnt habitat that total $\pm$ 16% of the available areas. All these patches have not been burnt for at least 2-3 years and vary in size considerably, by far the largest being 83.5 hectares. According to my estimation and conversation with forest officials the remaining 3-4% thatchland that was not burnt in 1977 was in fact burnt in 1976. The cover in these areas was substantial but not nearly as dense as in the areas unburnt for several years (i.e. the 16% habitation areas). Again these comprise small isolated pockets and pigmy hog and hispid hare are definitely not resident in these places, though there is frequent evidence of pigmy hog foraging excursions where a particular patch in contiguous with a known habitation area. The actual distribution pattern of the unburnt habitat in Barnadi is also significant in view of the fact that burning is undertaken

illegally by local villagers and herdsmen. Thus the most important unburnt habitat areas are in the immediate vicinity of the range office and beat office and are near or between good firebreaks namely the perimeter road and jeepable tracks.

The estimation of total populated habitat in Barnadi was undertaken simply by measurement and compass bearings of each patch of unburnt habitat. From the sum total area of this habitat it is possible to derive a maximum population estimate by determining the density of animals per unit area. For pigmy hog density was deduced by random sampling (i.e. by measuring areas covered during drives to capture two males for the attachment of radio harnesses and counting numbers of animals seen in each area) and by the subsequent determination of home range by telemetry having given consideration to average sounder composition, i.e. an average 4.5 animals per sounder at this time of year (Oliver 1977). Both methods are rather crude but in the event produced remarkably similar results i.e. 1 pigmy hog/$\pm$5.5 hectares. Therefore the maximum estimated population (prior to an expected birth peak in late April/early May (Mallinson 1977) is approximately 35-40 animals for the whole Barnadi area (though the population is actually lower than this due to direct hunting mortality; see later text for explanation).

Similar figures for hispid hare were not determined and no real data was obtained on current population levels of this species. However the population of hispid hare is undoubtedly low in view of the general scarcity of their distinctive demarcation deposits even in ideal habitat. Moreover their distribution in Barnadi is even more restricted than that of pigmy hog as they were found only in the largest areas of unburnt habitat.

M. K. Ranjitsinh visiting the Barnadi Forest in April 1972 wrote "In the reserve itself there is very little grazing and other factors of human disturbance though I saw evidence of grass cutting for thatch purposes and a few head of cattle on the southern side. On the whole however the reserve has been very well preserved as the areas has been converted to a plantation. There has been effective protection from fire and the area remains a dense high grass biotope".

It is therefore quite apparent that this area has deteriorated dramatically in the last few years. The simple fact of burning has had ecologically disastrous consequences on these resident species. Moreover, the species-habitat vulnerability consequent of burning is exacerbated disproportionately so that hunting, thatch collection and other human disturbance causes further disruption and erosion of the small remaining areas and 'float' populations. The latter being the viable nucleus that represent the future population continuity of these areas.

Analysis of factors affecting population levels in Barnadi and elsewhere

The association between pigmy hog sightings and burning is well known but its profound effects on their population has not been appreciated. Even Hodgson (1847) publishing his original description of the pigmy hog, wrote "that when the annual clearance of the undergrowth of the forest by fire occasionally reveals pigmy hogs, the herd may be assailed to advantage". As has been pointed out, burning is not a new phenomena, it has been practised for generations and yet these species have survived. However, we must consider the species/habitat situation in the present context for it has changed dramatically in the last few

decades with the progressive erosion of habitat and its replacement by agricultural settlements.

Burning is undoubtedly the single most important criteria affecting the population of these species in Barnadi. Barnadi however is by no means unique in this respect as annual burning is an accustomed and accepted practice that is widely considered to be beneficial. Whilst its impact on Barnadi is now self-evident, the issues raised by annual burning are complicated by several related factors. These factors naturally vary from place to place and it is important to analyse them in some detail.

1. *Loss of Habitat through settlement or encroachment*

The demand for new settlement areas with an increasing human population is, of course, the fundamental reason for the reduction in wildlife areas. This demand for land could reasonably be expected to apply to the whole spectrum of Indian wildlife, but in fact pressures for land are unequally applied. The physical difficulties and erosion problems associated with hill settlement have not so far affected these areas in Assam as seriously as elsewhere and as a consequence the primary deciduous and evergreen hill forests are still continuous and extensive.

By contrast thatchlands which are essentially well drained savannah are under the greatest demand for land for settlement and cultivation for they are flat, thinly forested and fertile. This land demand has effectively resulted in the loss of all former high grass habitat for wildlife except in the forest and wildlife reserve areas. Wildlife Reserves and Sanctuaries are few in number and it can be argued that Reserve Forests have assumed a new significance as wildlife areas. Yet as potential wildlife refuges, these remaining thatch areas are very unsatisfactory for they are also under very considerable encroachment, government settlement and exploitation pressure.

This pressure is likely to be maintained if not increased as land becomes increasingly at a premium as established encroachment areas tend to expand rapidly and eviction proceedings are lengthy, expensive and difficult owing to the human problems involved. Additionally the close proximity of forest areas to agricultural settlements not only isolates these areas but inevitably leads to abuses of forest reserves such as poaching, illegal grazing and illegal thatch collection .Control is difficult owing to poor communication facilities and the ease of access to forest areas owing to the long perimeter boundaries common to both forest and the surrounding cultivation areas.

The lack of an intervening 'buffer zone' between cultivation and forest areas is highly significant because the forest reserves are now essentially peripheral to human habitation and the close proximity of thatch areas to human habitation and activity, inordinately increases the risk of accidental or deliberate burning.

2. *Loss of habitat through annual dry season burning*

Annual burning is by no means a new phenomena as systematic and extensive grass-scrub burning has been practised for hundreds of years. However, the situation has changed drastically in the last few decades. Where previously burning extended well into forest areas, there were always areas too remote to be regularly burnt, if at all. Now with settlement extending as far as the Reserve Forests themselves all thatch-scrub areas are in the burning zone and virtually all areas are subject to deliberate burning or liable to accidental burning. At the present time the practice of burning would seem to be comprehensive and

the long practised tradition of dry season burning has not taken this change in circumstances into consideration.

As burning effectively destroys a vast percentage of available (potential) habitat, annual burning obviously serves to keep population of these species at low levels. Any systematic population increases by reproduction will be offset by the amount of available habitat and further reduced by poaching and other factors.

Direct mortality by burning is probably insignificant for pigmy hog (owing to their relative mobility and the coincidental appearance of displaced animals elsewhere) though one hunter assured me he had eaten pigmy hog that had been killed in this way. Alternatively by virtue of their delayed flight reaction (i.e. the tendency to freeze typical of hares) hispid hare may well suffer high mortality during burning.

Undoubtedly however the factor most affecting their population is the temporary loss of ground cover clearly essential for both species. The fact that pigmy hog travel long distances (say two or three miles) to reach the cover afforded by tea estates amply demonstrates this contention. Food and other incidental factors are of secondary importance to the predominant desire to seek cover. In this context we may quote a foremost Indian authority, the late P. D. Stracey (1966):

> "Food and shelter are the essential requirements for existence in an area and the adequacy of supply determines the degree of attraction of an area for a species. These are obviously to be measured at the period of lowest supply which may be in the wet or dry season and the number which an area can carry at such times is called the 'carrying capacity'. All numbers produced in excess of the carrying capacity are obviously subject to loss".

It is evident therefore that the extreme loss of habitat renders the 'carrying capacity' small, i.e. directly proportional to the amount of unburnt habitat. There is no doubt at all that the dry season is anyway the period that the population of these species are subject to the greatest natural pressure as resources, food/water supply etc. are at their lowest and the consequent destruction of habitat (shelter) by fire therefore has disastrous consequences on the resident population. Stracey goes on to say:

> "Similarly shelter may be measured in terms of quantity and|or quality and lack of mal-distribution of this factor is reflected in a low population. Shelter must protect the species from the elements as well as from enemies and must ensure safe feeding and breeding facilities. It must also satisfy the instinctive needs of the species and the 'animal pattern'. The instinctive behaviour pattern of a species is relatively fixed and modification of the conditions of shelter which it requires will bring about a reduction in its numbers in the locality".

Thus burning not only reduces habitat availability enormously, it also isolates remaining unburnt habitat so that other deleterious factors are concentrated on what is left to further reduce the remnant population.

Thus the situation for these species is very serious because of burning and becomes acute for the remaining population in the post-burning period.

3. *The destruction of habitat by forestry*

The advantages of burning for forestry practices are quite clear cut but must be reviewed here in the context of general discussion. Not unnaturally the primary consideration with respect to burning the Reserve Forests is its effect on forestry practices and its effect on wildlife is at best a secondary consideration, if it is considered at all.

Annual burning is an official Forest Department policy in many areas partly as an aid to forestry itself and partly to prevent burning

by other persons at a later date which would be more harmful to forest plantations. In essence therefore most burning by forestry officials is 'early' controlled burning in plots by fireline demarcation. This deliberate controlled burning is undertaken when the grass is not 'tinder-dry' in December-early February. Whilst this controlled burning does in fact sometimes get out of control it is far less harmful to young plantations than later uncontrolled burning in the height of the dry season. The latter can easily destroy a whole and very valuable plantation area, as happened in Khalingdaur Reserve Forest in the early 1970's. Thus early burning effectively clears thatch-scrub undergrowth which represents a serious fire hazard at a later date. The fact that the 'thatchlands' are the main target for afforestation programmes renders this fire hazard a very real threat in view of the ease with which dry season fires are started, particularly when so many persons, both official and unofficial, have access to forest areas.

Another reason for deliberate burning has already been outlined, i.e. the clearance of thatch-scrub which competes with young plantations for light and other resources. This clearance is a necessary prerequisite for the successful growth of young trees and for this reason thatch may also be regularly cut following rapid growth after the 'chota' rains.

Similarly thatch burning is also necessary to maintain high thatch yield as regular annual burning inhibits the growth of most other species and ensures an even growth of thatch that is of high quality and quantity. By the same token this also facilitates its harvesting as a commercial crop which is sold on a tender system, the thatch being collected into bundles and auctioned. The thatch-mahal itself is collected between September and April (though specific dates vary from locality and locality) and it provides an important source of revenue to the Forest Department. Nearly all large expanses of thatchland are therefore subject to mahal, though not all areas are burnt by forestry officials. However virtually all areas are in fact burnt one way or the other and thatch collection (whilst not a serious disturbance in itself as it concentrates mainly on burnt areas) obviously encourages burning as thatch yield is undoubtedly improved. Moreover, many areas of thatch that are not subject to an official mahal are still burnt for domestic thatch collection by villagers or by local forestry officials for their own purposes even though the thatch thus produced is often far in excess of their actual needs.

In view of the ecologically disastrous consequences of burning on resident wild species, forestry for afforestation and thatch-mahal purposes, directly results in the destruction of the vast majority of otherwise suitable habitat. It is therefore apparent that there is a direct conflict of interests between wildlife and forestry in these areas. It is true that the Reserve Forests are not wildlife areas, but for the pigmy hog and hispid hare they represent the only areas of distribution except for the Manas Sanctuary. It is irrelevant whether the burning consequent of forestry and thatch collection is the early controlled burning by forest officers or later uncontrolled burning by other persons for the effect on the habitat is equally disastrous for the ecology and conservation of these species.

Whilst burning is necessary for the successful growth of young trees, mature plantation could easily support thick thatch-scrub, but in areas like Barnadi thatch-mahal effectively precludes this possibility. Though most plantations are mono-culture, where trees are widely spaced the effect on undergrowth is negligible, but close planting for species like teak also

prevents the growth of cover in mature plantations. Elsewhere, undergrowth burning is undertaken (e.g. for sal in Balipara Reserve Forest) to prevent competition to germination from mature seeding trees.

Lastly the oft-mentioned argument that if thatch-scrub is not regularly burnt it would be completely superseded by forest, is in my view highly questionable. Basically the contention of this argument is that open thatch or grassland as a habitat is only maintained by burning and if burning was discontinued it would be quickly and successively displaced by secondary and eventually primary forest. It is, of course, true that there is a long term dynamism in the structure of habitat, but long term trends are irrelevant to these species when the short term effects of burning are so catastrophic. Moreover it is not possible to have it both ways, if the thatch-scrub of natural savannah is burnt to facilitate the growth of young trees in plantation, then that same cover will also inhibit the growth of natural forest. Certainly forest clearings revert back to forest if left (assuming erosion is not severe), but we are dealing mainly with natural savannah that has survived largely unburnt in formerly remote and inaccessible areas. This natural savannah may be thinly forested and still survive as thatch-scrub, indeed mature plantations of widely spaced trees could well represent a most important possible refuge for these species. There is evidence that if left unburnt, there is a noticeable increase in secondary forest growth with the relatively rapid appearance of such fast growing trees as simul, sishu and khier (D. K. Lahiri Choudhury, pers. comm.) though these tend to be widely spaced and the thatch-scrub is not deleteriously affected by this process. In fact one area of Barnadi approximately 63 hectares in extent was comprised entirely of mature secondary forest and had a very heavy thatch-scrub undergrowth and this was one of the best areas for both species. It seems unlikely that the typical primary forest would entirely displace this habitat and if burning continues at its present rate the argument would anyway be academic (as it would take too long for consideration in the urgently required short term conservation of these species). The management of open savannah for wild species would therefore be much better directed at actual management of tree growth (e.g. by ringing trees) than by burning entire areas to remove this doubtful eventuality.

4. *The destruction of habitat by burning for grazing*

Whilst the arguments about afforestation and thatch-mahal do not, or should not apply to Sanctuaries and other declared wildlife areas, annual burning of the grasslands is nonetheless undertaken to a great extent in these areas. Part of the reason given is that controlled burning is also less destructive to habitat and wildlife than the likely subsequent uncontrolled burning at a later time. There is a very real risk of fire even in Sanctuaries during the dry season from tourists, sanctuary officials, labourers and bordering settlements and controlled burning does enable large and mobile stock to get out of the way of fire and it is less destructive to forest. The additional argument that most species migrate during the dry season and are therefore not affected is fallacious and is anyway inapplicable to these and other resident species as we have seen.

However, controlled burning is also undertaken in Sanctuaries and elsewhere to improve fodder for grazing herbivores and I would contend that there is considerable fault to find with this argument. Whilst it is true that grass/thatch yield (i.e. fodder) is undoubtedly in-

creased by burning in the same way as that undertaken for thatch-mahal, there is no evidence that shortages of fodder is the factor that is controlling the population of any of the grazing ungulates in these Sanctuaries. Species populations are always controlled by the least favourable factor in any particular environment, and it is highly doubtful that in a high-grass biotope fodder is in short supply (except perhaps ironically in the post-burning period). It is true that the young shoots that grow after the 'chota' rains in burnt areas are a favoured fodder, but it is hardly possible to justify the distortion caused to the habitat by the selective effects of burning on this account. Even if burning could successfully bring about an increase in herbivore population resulting from improved fodder yield, the pursuance of this policy would result in the artificial maintenance of an over-optimum population of a few species at the expense of a whole variety of others.

Stracey (1963) summarises a section on the protection of game habitat by writing:

> "The lesson to be drawn from all this is the need to preserve intact, as far as possible, the biotic complex so as to ensure the free interplay of these forces of nature of which we have so little real comprehension. Any attempts at protection of the forest as such or as a game habitat by artificial means, must be embarked upon with the utmost caution, particularly when they aim at the reduction or elimination of one or more species and the maximum reliance should be placed on biological or natural methods of control."

It need hardly be said that burning is neither biological or natural, certainly electrical storms can cause fire but the frequency with which this happens in the dry season is negligible, electrical storms are essentially a wet season phenomenon.

There are only two Sanctuaries in the known area of distribution of the species, i.e. Manas and Sonai-Rupa, and both are subject to extensive burning. Manas is probably the most important area for the future conservation of pigmy hog/hispid hare but it is extensively and deliberately burnt over most areas for the above mentioned reasons even though it does not support a very heavy population of grazing herbivores. Hispid hare have not been recorded from Sonai-Rupa and pigmy hog are probably extinct now in this area though they were formerly known to occur there. Regular burning for thatch-mahal in this sanctuary until two years ago may well have caused the disappearance of this species. Part of Sonai-Rupa is still burnt and this is not controlled burning but 'accidental' burning primarily by herdsmen from a mixed cattle and buffalo 'khuti' (permanent graziers camp) who have grazing rights in the sanctuary.

Burning by villagers and herdsmen for the improvement of grazing for domestic herbivores is a very important factor in some areas such as Khalingdaur Reserve Forest where herdsmen from a two hundred head buffalo khuti have totally burnt approximately 9 sq. miles of thatchland in an area that was previously known to support pigmy hogs. No pigmy hogs have been seen this year which is most unusual, and quite conceivably represents the loss of this population. This burning may have been deliberate to improve grazing (there is no thatch-mahal in this area) or accidental as the herdsmen are smoking or cooking their meals in the forest. Grazing concessions in forest areas enormously increases the risk of burning even if the burning is not deliberate. In Barnadi the illegal grazing by domestic cattle represents a source of fire from attendant herdsmen and in some parts the intensive grazing severely curtails the growth of thatch following the 'chota' rains. More significantly perhaps the only source of thatch for fodder is the immediate post-burning period in the

unburnt areas that support the residual population of pigmy hog and hispid hare. These areas in Barnadi are therefore subject to considerable and continual disturbance by both cattle grazing the area and more particularly by herdsmen and villagers collecting bundles of thatch for fodder for domestic animals and for their own purposes. Relatively few Reserve Forests have grazing concessions in this area and grazing of domestic animals is not allowed without prior permission that may be granted in special cases (e.g. to forest villagers who have grazing rights for their own cattle on a ten head per household basis and these are censused every year). The heavy illegal grazing is exceptional in Barnadi and in view of the shortages of game species in this highly disturbed areas, grazing itself is probably not particularly deleterious if it was not so concentrated, especially on the unburnt areas following seasonal burning. However, even light grazing by a few domestic animals involves human activity with an inherent and serious associated fire hazard that is much more significant in these respects, e.g. Khalingdaur.

Hunting

Direct mortality by hunting or poaching is also a serious threat to these species. Again we are faced with this problem that hunting, particularly of pigmy hog, becomes far more significant in the post-burning period. Barnadi is regularly visited by hunters (poachers) working independently or in small parties from village settlements and tea estates. These people naturally concentrate their activities mainly on unburnt areas for the obvious reason that these are the only areas where cover (and therefore game) is to be found in the high grasslands following burning. The isolation of the small unburnt areas therefore facilitates hunting enormously as hunters can be deployed only in these areas and can screen randomly for game, set snares or gin traps or drive animals out of cover. I can testify to the effectiveness of the last method because this was the method used under permit to catch pigmy hog in nets for the temporary attachment of the radio harnesses during the study. Game such as pigmy hog, that is driven out of cover is either run to exhaustion on surrounding open land or killed with bow and arrow or shot gun as it breaks cover. To my own certain knowledge at least five animals were killed in Barnadi in this way during the late March to May period. This may not seem a particularly high mortality but this in fact represents direct poaching on the very small remnant breeding population that is the main basis for the continuance for the species in the area. Therefore those pigmy hog known to be killed in this period in 1977 is actually approximately 14% of the total estimated population for this whole area.

It is well known that pigmy hog and other species are most easily caught after the grasslands have been burnt and it is no coincidence that all captive animals caught since 1971 have been captured in the period. As one hunter told me "If you want to catch pigmy hog you have to do it after burning but before the rains when the grass grows so there is more cover and hunting is difficult."

Not all hunting takes place in the Reserve Forests for the main pigmy hog actual hunting mortality is likely to occur in the displaced populations found on local tea estates as already outlined. But whatever the source, pigmy hogs were formerly commonly to be observed for sale as food in local bazaars during this period and the original Attareekhat acquisitions were obtained in this way. They are rarely sold in bazaars now as they are likely to be recognised by forest officials and

the hunters and retailers are therefore liable to prosecution. There have been no prosecutions to date however, though they are still hunted regularly in Barnadi during this period, though animals are usually butchered immediately so that they cannot be easily recognised.

Gin traps are also easily available for sale in bazaars and the large number of disabled animals purchased for the tea estate captive stocks testify to this method of hunting (Mallinson 1971). Hispid hare also caught and killed in this way. Of course, gin traps are largely indiscriminate, but so too are the hunters themselves for almost any animal caught is liable to be eaten or parts of it sold for medicinal purposes.

This lack of discrimination is even more directly significant for hispid hare as most local people simply do not distinguish between hispid hare and ordinary hare (*Lepus nigricollis*) and the latter can be hunted legally in agricultural areas. Some hunters of course do appreciate differences between the two sorts of 'rabbit' (hence the local dialect names: 'Nul Keria', 'Khagra Katta' or Ekra Kata Shoha' for hispid hare and 'Loha-Pohu' or 'Khargosh' for the Indian hare) but they still fail to appreciate that you can hunt one sort and not the other or the reasons for it. Unlike pigmy hog which hunters are cautious about hunting, the rarity of hispid hare is not known and even most local forestry officials do not recognise the species or its status. Information about hispid hare is consequently much harder to come by and this is reflected to some extent in the incompleteness of the data collected about this species. Apart from gin traps and snares, both sorts of hare are mainly hunted at night with a torch and this method may be so refined by experienced shikaris that animals can be approached over open ground within physical striking distance. Hunting parties with torches were to be regularly seen screening paddy fields systematically for foraging hares that have emerged from the Reserve Forest. The villagers claim that they are not poaching as the animals are outside reserve boundaries and are anyway damaging their crops. The author never saw hispid hare whilst looking for them at night with a torch, though there were many Indian hare active in these fields. However reliable sources of information assure of the similar activity of hispid hare and I saw a skin of one that had been killed in this way.

Poaching in Barnadi is probably more serious than in most Reserve Forests and in some poaching is probably negligible at the present time. In Barnadi the long common perimeter to settlement areas is again significant as it renders anti-poaching policing difficult. Poaching in Manas for these species is probably not serious if it occurs at all, as other game is more profitable and anti-poaching measures have reduced poaching significantly (P. Lahan, pers. comm.). However most pigmy hog and hispid hare populations are unlikely to be in the vicinity of settlement areas owing to the extensive burning.

Other sources of disturbances

Primarily these include such (illegal) activities as collection of forest vegetables, firewood, domestic thatch collection out of season (i.e. between 31st April and 1st September) and other forest resources. Some areas such as Barnadi also have by-ways through the forest which are used by local settlers as well as forest villagers. These activities themselves are not particularly harmful other than the fact that they again disturb the small unburnt areas for they are the only source of such resources in the post-burning period. More particularly, such activities are also a serious fire hazard especially if the burning of most areas has

been undertaken early, thereby leaving the remaining unburnt areas highly vulnerable to fire for two to three months prior to the chota rains.

Areas of distribution in N. W. Assam

Owing to the difficulties mentioned earlier it was not possible to visit all known or likely areas of distribution. Where it was not possible to visit personally, attempts were made to gather as much information as possible from local forestry officials or employees, local villagers and shikaris and similar sources of information. For some of these areas there is no information available regarding the presence or absence of the species, but particular Reserve Forests or Unclassed State Forests have been included in a summary of known distribution as they fall within or between known localities and are known to encompass similar habitat areas.

There are four 'divisions' in north-western Assam that fall within this known area of distribution, i.e. (from west to east) Kachugaon, Haltugaon, North Kamrup and Darrang Divisions. The two most important districts are Darrang and North Kamrup Divisions; and these areas have been assayed as well as time and circumstances permitted.

1. **Darrang Division**

Gophur Reserve Forest: Pigmy hog are definitely known from this area at the present time and there are also recent records of hispid hare. There are approximately 16 sq. kilometres of thatchland on the north-eastern edge of the Reserve, but this whole area is subject to two separate thatch-mahal concessions and as nearly all areas are burnt the pigmy hog population must be small. No grazing in this area, but formerly much encroachment although over 3,000 people have been evicted. The thatchland reclaimed in this way is being afforested with simul and udal plantations however.

The geography of this area would make it suitable for the prevention of burning in some areas as access to thatch area is limited to the western river boundary, as it is otherwise surrounded by primary forest.

Naudaur Reserve Forest: Pigmy hog are also definitely known from this area at the present time though again the population is very low. No records of hispid hare. Total reserve area is 67 sq. kilometres but more than half of this area is leased as a firing range. Only about 30 hectares of grassland within Reserve boundary and most of this borders the Bordukari River and as it tends to get waterlogged is unlikely to support pigmy hog. A large thatch-bari on the outskirts of the reserve is under disputed ownership but is, like the 'char' thatch area within reserve, subject to mahal and is totally burnt. Small patches of thatch within the forest itself are not subject to official mahal but are burnt for private thatch collection by forest officials, though much of the thatch produced is superflous to their domestic requirements. These latter areas could well be protected from burning. Pigmy hogs are only seen in these latter areas and always in early April following burning.

Balipara Reserve Forest: Pigmy hog occur in one small area of this Reserve but no records of hispid hare. The population must be very small for this area is only approximately 200 - 300 acres and is comprised of mixed thatch—tara (*Cardaman* sp.) jungle, though this is presently undisturbed. However there is a government-granted collective farm immediately to the south-east of this area which might easily affect it. Only other thatch is char grassland on the north-east side of the Borelli River, which is subject to a thatch-mahal but

as it also gets waterlogged or flooded during the monsoon it does not support pigmy hog. Efforts should be made to maintain protection of the one small area where pigmy hog are believed to occur.

Sonai-Rupa Sanctuary: Pigmy hog probably extinct in this area, no records for hispid hare. This sanctuary is part of the Charduar Reserve Forest, but it has not been maintained or developed as a wildlife area. Regular burning and thatch-mahal was stopped in 1975 but pigmy hog had long disappeared by that time having last been seen about 30 years ago. Some areas within an approximate 13 sq. mile thatch-scrub belt are still burnt by herdsmen from a mixed cattle and buffalo khuti who have permanent settlement and grazing rights in the sanctuary. The State Government has also leased approximately 63.8 sq. kilometres of the sanctuary to the army as a firing range, including heavy artillery and for large scale troop manoeuvres. The army has applied to lease a further area of approximately the same acreage, though the Forest Department has requested the army to vacate as it hampers operations to develop the sanctuary. There are no reports of the army actually killing any game but the disturbance is obviously considerable. This would be an ideal area for the reintroduction or translocation of pigmy hog if the sanctuary was brought up to its nominate status.

Rowta Reserve Forest: Pigmy hog definitely known to occur in this area but the population must be extremely low. No records of hispid hare. The one area of thatchland, approximately 80 hectares in extent, has a complete mahal and the whole area is subject to uncontrolled burning usually in March. Only a very small strip of mixed thatch-scrub forest running along the edge of this mahal area is unburnt. Pigmy hogs were seen this year in late March after burning. There is no grazing in this area, but extensive timber extraction.

The geography of this area could well protect the thatch against fire as access is well guarded and the thatch area is well within the confines of the forest. Moreover the value of the thatch-mahal is very small.

Corromore Unclassed State Forest: Pigmy hog occur in this area but again population probably very low as nearly all areas burnt. No record of hispid hare. Wild elephant in the area prevented closer examination of the one small area likely to support pigmy hog on the western side. Little encroachment as yet but dwellings have appeared over the last year.

Khalingdaur Reserve Forest: Pigmy hog definitely found up to 1976, though now much reduced if they survive at all. No definite records of hispid hare. Very large areas of thatch on north and western side of this area, but these have been entirely burnt mostly by herdsmen of a buffalo khuti. Records of pigmy hog on Nonaipara Tea Estate are derived from population formerly living in Khalingdaur which is immediately to the north of this garden. However this population area has now been converted into a plantation and this whole habitat zone is now subject to controlled burning and no pigmy hogs have been seen this year. There is no thatch-mahal. Two large thatch areas to the east are also deliberately burnt despite having a natural fire break afforded by the Dhansiri River. Previous records of pigmy hog in Haltigaon and Majuli Tea Estates are derived from animals on this side. This eastern area could be protected from fire and would be an ideal area for pigmy hog if the animal still survives there.

2. **North Kamrup Division**

Barnadi Forest Reserve: Pigmy hog and hispid hare definitely found here. Still one of the

Scale 1′ — 16 miles

NORTH KAMRUP DIVISION

Key 1. Manas

2. Doadhari Reserve Forest
3. Batabari Reserve Forest
*4. Diwara Reserve Forest
5. Subankhata Reserve Forest
6. Darranga Reserve Forest
7. Barnadi Reserve Forest

DARRANG DIVISION

8. Khalingdaur R.F.
9. Corromore U.S.F.
10. Rowta R.F.
11. Charduar R.F.
12. Sonai-Rupa Sanctuary
13. Balipara R.F.
14. Naudaur R.F.
*15. Biswanath R.F.
*16. Behali R.F.
17. Gohpur R.F.

* Reserve Forests are comprised entirely of primary forest.

Fig. 3. Reserve Forest distribution of the most important areas for pigmy hog and hispid hare in North Kamrup and Darrang Districts of North-Western Assam.

most important regions for these species, this area has undergone progressive deterioration and it is unlikely that either species will survive if this pressure continues. Thatch-mahal and afforestation programmes over whole area, coupled with a tremendous amount of illegal human activity. This area is very difficult to proteet owing to long perimeter boundary to surrounding cultivation area and it is doubtful that proposed protection measures will be effective long term. For details see previous section.

Darranga Reserve Forest: Pigmy hog definitely known to occur in the eastern side though population probably low. No definite records of hispid hare. There is a continuous strip of thatch and all along southern half of this forest, but nearly all thatch is burnt and there is a thatch-mahal concession for this entire region. There is an army firing range on the western side. Fire protection measures should be taken in the eastern side though long common forest-cultivation boundary, similar to Barnadi, may render this difficult.

Subankhata Reserve Forest: Pigmy hog probably found in this area though flooding of access roads prevented confirmation. No definite records of hispid hare. A small thatch area on southern side may well support pigmy hog, though this area is subject to mahal and is largely burnt. This thatch area runs north-south, so there is a relatively short common boundary with cultivation areas to the south which would facilitate protection against burning and the value of the thatch-mahal is small. An additional small Reserve Forest area to the south-east, i.e. Morapgaldia Reserve Forest, is a good thatch area, but is entirely burnt and all parts subject to mahal and afforestation and therefore unlikely to support this species.

Batabari and Doadhari Reserve Forests: No definite records of pigmy hog or hispid hare, but flooding prevented access to the region. Small thatch areas in these reserves may support pigmy hog, but despite lack of thatch-mahal, nearly all areas are burnt.

Manas Sanctuary: Pigmy hog and hispid hare both found in this region which is probably the single most important area for the future conservation of these species. However the population of both species must be much lower than it should be owing to the very extensive early burning for prevention of accidental burning and the improvement of fodder. There is a total of approximately 40 sq. kilometres of thatchland in sanctuary area, of whieh approximately 12 sq. kilometres on southern side and 15 sq. kilometres on the western side of the Manas River make up the bulk of this total though practically all of both these areas are burnt. Small areas within forest belts and at the edges of the large thatch belts remain unburnt and harbour the resident populations of these species. Pigmy hog have been recorded from several places in the sanctuary including the eastern side in the former Kakihabari Reserve Forest, in patches in the central and southern areas and on the western side of the Manas River. Fire prevention measures in Manas are wholly directed at early controlled burning by firelines to prevent the likely accidental burning from persons having access to the sanctuary and from neighbouring border settlements. However efforts must be made to reduce the extent of burnings in view of the importance of Manas for these species.

3. **Hultugaon Division**

This area was not visited. There is a reported sighting of pigmy hog near Rumikhati (D. K. Lahiri Choudhury, pers. comm.). Other reports of pigmy hog and hispid hare have been recorded in the vicinity of Goalpara

Forest Division to the south but these have not been confirmed recently. A hispid hare was collected there in 1956. There is a large belt of approximately 60 sq. kilometres of mixed thatch-scrub to the north of this division between the Sarbhanga River in the west to the Kanamakra River in the east (S. K. Chetia, in litt.) which may well support these species though no reports of them have filtered through. There is some human habitation in this latter region and much of this area is burnt by the villagers who collect thatch for their own purposes though there is no official thatch-mahal. This area needs further investigation.

4. **Kochugaon Division**

This area was not visited and there is very little information available appertaining to it. However pigmy hog have been recently reported from one locality, i.e. near Raimona Forest Rest House between the Janali and Rouya forest areas (D. K. Lahiri Choudhury, per. comm.). This area also needs further investigation.

The apparent poor distribution of hispid hare is significant, for it reflects not only a very poor local knowledge of this animal but a probable real paucity of the species over this known range. Whilst it is important to consider that some of these areas may well support small populations of hispid hare, some almost certainly do not (e.g. Balipara Reserve Forest) as local shikari knowledge is sound and if the species were to be found there it would have been reported. By contrast, whilst the range of the pigmy hog may seem considerable, it must be remembered that in view of the ecological instability brought about by the burning of the vast majority of all these areas, this species must have an extremely tenuous hold in most places.

The only way of estimating resident populations in these areas is by ascertaining the total area of inhabited unburnt thatch-scrub, and this of course varies year by year. Whilst this was done in Barnadi in 1977, it was clearly not possible to do this over the entire range of distribution and I have made no attempt at a total population estimate for pigmy hog, though it is felt that it is unlikely to be more than one hundred and fifty to two hundred animals and may well be considerably less than this. Moreover any population estimate is largely meaningless in view of the extreme vulnerability and instability of the habitat, and therefore of the species. Suffice to say that population levels are certain to reflect this ecological instability and it is certain that pigmy hog and hispid hare numbers will continue to decrease unless their environment can be stabilised by the prevention of burning in some areas.

Conclusions

It is quite apparent that these species have undergone a dramatic decline in distribution over the past few decades and that this process is continuing in the last remaining habitation areas of N. W. Assam. Even such a cursory analysis of the pressures affecting this remaining habitat and its resident populations of these species shows that their future is also extremely precarious throughout most, if not all, of their present range of distribution. The fact that the 'thatchlands' are essentially flat, well-drained savannah which is ideal for agriculture and forestry, has meant a disproportionate loss of habitat for hog and hare over their entire former range. Furthermore, not only have the processes of settlement and encroachment reduced former habitat areas to within or even beyond declared forest boundaries, but that the vast majority of whatever natural habitat remains is further despoiled

by burning and other forestry practices.

The situation for these species is particularly acute for a number of reasons, not least of which is that the surviving populations are largely restricted to Reserve Forests, and these areas are not actually wildlife areas and have no real policy regarding wildlife conservation. Of declared wildlife areas, only Manas Sanctuary supports known populations and the vast majority of otherwise suitable habitat in Manas is spoilt by the widespread seasonal burning. Therefore whilst we must appreciate that the primary function of the Reserve Forests is the commercial exploitation of the forests as a resource, it should also be appreciated that they must have additional significance as an extremely important last refuge for these species, and they do support most of the total surviving populations.

Forestry and wildlife are largely incompatable however, and at the present time we are witnessing the progressive decline of wildlife habitation areas that is primarily a function of dry season burning coupled with the increasing exploitation of thatchland for afforestation, thatch-mahal and grazing. So great is the rate of destruction of this environment, that it is somewhat surprising that they have continued to survive at all in many of these areas. As it is, we can certainly expect the systematic loss of most of these populations over the next few years if the present pressures on this habitat continue, as they are almost certain to do.

All results lead to the inevitable conclusion that the long tradition of dry season burning as the fundamental problem affecting the remaining populations. However the effect of burning on small resident species has never been seriously considered or appreciated. Neither has the change in circumstances been taken into account, i.e. the reduction in wildlife areas so that few are now too remote not to be subject to burning. As we have seen, this burning of thatch-scrub effectively destroys, or severely distorts, the vast majority of otherwise suitable habitat. This serves to keep resident populations at low levels that are approximately proportional to the amount of habitat left unburnt for several successive years. Moreover the nature of uncontrolled burning obviously results in a good deal of variance in the extent (severity) of burning year by year, and a particularly severe burning can reasonably be expected to result in the complete extermination of whole populations by the total, or near total, destruction of available habitat.

Official fire policy in Reserve Forests is essentially the controlled early burning where fire is a hazard to plantations and though uncontrolled burning is not actually allowed, it has not caused much concern where it has not directly affected such interests. The early burning that is an integral part of many forestry operations does serve to inhibit or prevent later accidental or deliberate uncontrolled burning and it is therefore undoubtedly good for forestry purposes, as tree growth is less affected and thatch yield is improved. This is particularly true where later uncontrolled burning is not so much a risk as a definite probability owing to human activity in forest areas or the close proximity of thatchland to bordering settlement and cultivation areas, e.g. Barnadi. This incidental burning by other persons is a very real problem as burning during the dry season is a tradition of long standing and in fairness it must be said that even if the prohibition of burning was better enforced by the Forest Department, it would still be unlikely to be prevented in some areas (M. A. Islam, pers. comm.). Moreover fire prevention is costly and difficult and though easily started, fires are very difficult to control.

Even so, the present extent of burning, either controlled or uncontrolled, cannot possibly be justified. Many areas, e.g. parts of Naudaur Reserve Forest, are burnt by forestry officials solely for their own domestic purposes even though they are unlikely to be burnt by other persons and there are no forestry operations in these small areas. The thatch yield produced by this burning is far in excess of these domestic requirements, which could easily be met without burning. There is no justification for burning for thatch when optimum yield is not required. In other areas, e.g. Rowta Reserve Forest, optimum yield is required for a total mahal is the only area of thatch, yet the revenue obtained from this mahal was only six thousand rupees in 1976 (approximately four hundred pounds sterling). Almost the entire thatch area in Rowta is burnt for this mahal and as a consequence the pigmy hog population is so small that it is almost certain to disappear altogether if the present burning continues. In Khalingdaur Reserve Forest the known indigenous pigmy hog population is now quite probably extinct as a result of thatchland burning even though there is no mahal. Controlled burning in Khalingdaur is undertaken only in plantation areas and the indiscriminate uncontrolled burning that occurs everywhere else in the Reserve is undertaken according to the whim or carelessness of herdsmen that have access to these areas from the official buffalo khuti. The total of approximately 9 sq. miles of otherwise prime thatch-scrub habitat that was burnt in 1977 is a result of these herdsmen's activities. Yet the revenue obtained from the grazing rights of this two hundred head khuti is only six rupees per head of buffalo, i.e. one thousand two hundred rupees (approximately eighty pounds sterling). Clearly therefore the revenue obtained from such activities is very small, whilst the cost is very high in terms of wildlife and typifies the way in which these Reserve Forest populations are being (unwittingly) squandered at the present time.

It is of course unrealistic to think that much thatchland savannah will be left for wildlife in Reserve Forest areas for there is an undoubted conflict of interests between forestry and wildlife. Moreover forestry exploitation is not just revenue—dependent for there is a genuine human interest in much of this exploitation particularly for thatch in view of its importance as a cheap and satisfactory roofing material. Burning for thatch-mahal will thus continue to account for a majority of this habitat for burning does improve thatch yield and facilitates its extraction and there is very little thatch available outside Reserve Forests (though many tea estates have thatch-bari's and auction thatch surplus to their own requirements). But there are many official mahals in areas where these species do not occur, but in those indigenous areas that have been listed, the burning (usually uncontrolled) consequent of mahal is very likely to eliminate these populations. In this context G. S. Chaudhury (pers. comm.) is intending to institute a policy in Barnadi of early and restricted thatch extraction (September to January) with no burning and this could be most significant for the populations there. Optimum yield would however be sacrificed, and in view of the ease with which Barnadi is burnt by miscreants at the present time, fire prevention measures would have to be improved enormously. It would be much more preferable if mahal were abolished totally (or in certain parts that could be protected) in the most important pigmy hog and hispid hare areas, as this would eliminate much of the necessity for burning. By the same token unofficial thatch collection by villagers for domestic purposes

would also be outlawed, as such activities are an inherent fire risk and greatly disturb the pockets of unburnt habitat in the post-burning period. The discouragement of private and illegal thatch collection by the prosecution of offenders would do much to prevent thatch fires by reducing the risk of accidental or deliberate arson. Similarly the domestic thatch requirements for forest settlements and forestry officials should be met without burning, or preferably with thatch supplied from elsewhere or thatch substitutes (such as rice straw, palm fronds or ideally, corrugated iron). Localised incidental burning for such purposes is particularly destructive as it tends to occur in the only areas likely to support species that have been eliminated elsewhere by official mahal.

Yet forestry itself need not necessarily result in the exclusion of resident species from these thatch areas even though this is undoubtedly the current trend. Most burning for thatch-mahal is presently uncontrolled, but if burning was carefully controlled there could be room for compromise, such as is envisaged for Barnadi. Mahal could be restricted to specified mahal areas within particular thatchland belts where these species are known to occur. Afforestation could also be adapted so that it did not conflict directly with wildlife interest. M. K. Ranjitsinh (in litt.) has suggested rotational planting and extraction actually as a means to conserve thatch-scrub habitat. Many plantations are on long cycles even fifty or sixty years (P. C. Das, pers. comm.) and thinly planted established trees could support a thick thatch-scrub undergrowth that would be ecologically stable for many years provided it was no burnt. Such areas support pigmy hog and hispid hare in Barnadi and the area of mature mixed secondary forest also in that locality, demonstrates that even fairly substantial cover does not preclude the heavy undergrowth that will support a rich fauna. Thus young plantations could be subject to controlled seasonal burning until established, as would suit forestry purposes, whilst adjacent plots could support these species. Such a system would have decided advantages provided a policy of fire prevention was adopted (rather than undertake controlled burning to prevent uncontrolled burning) as animals eventually displaced by the cropping of sufficiently mature plantation, would have spill-over habitat in the young but established plantations. In this way, what are at present highly negative aspects of forestry in terms of wildlife, could be made to make a very positive contribution to conservation, without loss of revenue.

The present policy of controlled burning to prevent uncontrolled burning is not a solution for wildlife as controlled burning is basically just as destructive to habitat (and therefore to wildlife) as uncontrolled burning. Both result in the total short-term loss of cover and other resources and the long-term distortion of habitat brought about by the differing fire resistance of plant and animal species. Thus the current practise of controlled early burning in Sanctuaries to minimise the risk of uncontrolled burning is merely a 'soft option' that is highly unsatisfactory. To prevent wholesale uncontrolled burning is one thing, but to justify wholescale controlled burning for fodder requirements for grazing ungulates is grossly irresponsible in my view. But many remote or inaccessible parts of the Sanctuaries in Assam, Manas included, are deliberately burnt on these grounds, even though there is very small chance that they would be burnt accidentally. Not only should such places not be burnt, but access to many such areas could easily be restricted to tourists and labourers during the height of the dry season to minimise the risk of accidental burning. Also pro-

paganda about the risks of burning should be displayed in areas where access cannot be restricted. There should be absolute prohibition of burning in areas which are also naturally less susceptible to fire hazard by virtue of the topography of the region, e.g. with natural firebreaks such as wet or dry watercourses or stretches of primary forest. Moreover other methods of control should be sought in Sanctuary areas where there is a high fire risk owing to their proximity to human activity. At the present time the cutting and burning of firelines is undertaken for the controlled burning of large areas, but these methods should be adapted to inhibit or prevent the spread of fire over large areas.

Moreover, not only is burning highly deleterious for these species, it is now actually illegal in Sanctuaries under Chapter IV, Section 30, of the Indian Wild Life (Protection) Act, 1972, which was ratified by Assam on 16th January 1977. Under this Act the argument about burning for the improvement of fodder is important as it could be argued that burning should be allowed under Section 33, Clause (c) as "measures for the improvement of any habitat." In my view this is clearly inapplicable as burning is totally destructive to the habitat of some species, and is only of highly doubtful merit for grazing ungulates, as argued earlier. However, this same section could allow for the burning and cutting of firelines to prevent the widespread uncontrolled burning, for which widespread controlled burning is partly undertaken.

These Sections of the Act are only applicable to Sanctuaries and National Parks and there is no legislation for the protection of their habitat over most of their range of distribution, i.e. in the Reserve Forests. The legislation applicable to these animals by their Schedule I categorisation only applies to hunting (in its widest sense) or possession of live animals or the whole or parts of their bodies. Hunting is anyway not allowed in Reserve Forests and although hunting still remains a problem in some areas (particularly in Barnadi Reserve Forest), it is not the major problem. The major problem is the destruction of their habitat.

This is a crucial argument. By virtue of the fact that these species are primarily endangered by the destruction of their habitat, they remain effectively unprotected in Reserve Forests. Thus as it stands at the moment, the Indian Wild Life (Protection) Act has little meaning or relevance to most populations of either of these highly endangered species. (This, of course, also serves to emphasise the tremendous importance of reducing the high level of burning in Manas, for this is the only area where the habitat of these species is legally protected).

Whilst reviewing the conservation measures that need to be adopted for the protection of pigmy hog and hispid hare, we must realise that these species are not only excessively threatened by the degradation of their environment, but they are actually symptomatic of that degradation. It is true that there is some direct pressure on the population of these species by hunting, but this pressure is insignificant compared to the large scale destruction of their environment. For conservation purposes it is irrelevant whether this destruction is official or unofficial burning or whether it is burning for afforestation, thatch-mahal or grazing. This is the irony of the situation, for the protective legislation for these animals is only related to hunting, and hunting only exacerbates a situation brought about by burning. Worse, hunting is actually facilitated by the process of burning as we have seen. Present methods of hunting would not be so effective

or even inapplicable in a non-burning situation and the mortality consequent of hunting would be comparatively negligible if the population was not so curtailed by the shortage of unburnt habitat.

Thus we should not just be considering the conservation of hog and hare, but the conservation of the thatch-scrub ecosystem itself. As has been said "faunal conservation depends on habitat conservation" (R. Strahan 1972). This is undoubtedly the most important consideration, for the conservation of pigmy hog and hispid hare in the wild also has implications for a host of other plant and animal species that are an intrinsic part of that ecosystem complex, but of which we have little or no knowledge. Again and again we meet the philosophy in amateur conservation proposals where the recognised dominant species (such as pigmy hog) are considered in terms of particular individual species problems. To consider the conservation of individual species in isolation, is not only putting them out of context it also carries a penalty clause, i.e. the alleviation of a pressure source to conserve a particular environment (and therefore its indigenous species).

Thus all the well intentioned conservation efforts directed towards captive breeding of pigmy hog in Assam, have not only been largely unsuccessful, but they have also ignored the fundamental problems of the wild situation. Captive breeding should not be regarded as a solution for the conservation of pigmy hog. Rather the conservation of pigmy hog should provide a lever for the conservation of the thatch-scrub ecosystem.

This is not to say that captive breeding is not important as it is very important for the reasons outlined in the introduction and must be maintained and improved. However, captive breeding must also be viewed in context and conservation priorities should first and foremost be shifted to positive measures for the protection of their natural environment. Such a policy also has obvious implications for hispid hare for which captive breeding is of very doubtful viability. The husbandry of hares is notorious difficult as already stated, and efforts to maintain this species in captivity have been undertaken with only the flimsiest understanding of their biology. For example, two pairs of hispid hare that were caught for Gauhati Zoo in March 1977 in Manas Sanctuary, all died within a few days of capture. In view of their previous captive record it is doubtful if these would have survived even had they reached their destination and these captures served no useful purpose whatever. It is very unlikely that similar efforts will be any more successful in the future without a much better understanding of their requirements and a specialist knowledge and experience of comparable species (which are more expendable at the individual specimen level).

By contrast, translocation may well be applicable to hispid hare and this technique could well have conservation potential for this species in view of their doubtful future over most of that present range. The same argument applies to pigmy hog in which the translocation attempt at Orang Sanctuary showed promising indications of success, despite the unfortunate choice of local and poor management of the project. Translocation as a technique applicable to these species has been dealt with at length within a separate report (Oliver 1977), but for our purposes here, it is as well to note that as some of the populations also have no future in their present locale, they could well be translocated. Unfortunately burning is so widespread that there is no locality in N. W. Assam that is sufficiently stable for introduction (or preferably

re-introduction) to be warranted, though Sonai-Rupa Sanctuary could well serve this purpose if it were brought up to its nominate status.

Conservation measures must be primarily directed at the protection or salvage of at least some of the small remaining habitation areas of these species. What is really required is a change of attitude about burning and an appreciation of its very serious consequences on natural habitat and resident species. A realisation of the ecological consequences should do much to reduce the present extent of burning. However specific conservation measures are needed and these require prompt and sustained action on the behalf of the authorities. That this action is against the habitual practice of dry season burning and may therefore conflict directly with forestry practices, is a meter of the problems faced. What has been lacking is an understanding of the casual factors in their continuing decline; but it is hoped that we can now demonstrate not only rarity, but also its cause and effect. That the pigmy hog and perhaps even more particularly, the hispid hare, have a precarious future should be in no doubt and they must be regarded as seriously threatened. However an objective analysis of the environmental problems faced by these species (admirably demonstrated by Barnadi) does not lead to optimism with regard to their future. The human responsibility for these species survival must not only be appreciated, but positive action must be taken quickly. If it is not, the empirical reprieve consequent of the reappearance of these presumed extinct species may well prove to be short lived.

Recommendations

A number of suggestions regarding the conservation of these species have been requested by M. A. Islam, Chief Conservator of Forests, Assam, and some of these have already been submitted to the Forest Department. These suggestions, together with further recommendations, are outlined below.

In making proposals, attempts have been made to be as objective and rational as possible about conservation, whilst at the same time acknowledging the primary function of the Reserve Forests as exploitation areas. Therefore whilst a blanket approach to the preservation of all known populations is not feasible and is not envisaged, it is felt that there must be room for compromise even if that conflicts to some degree with the interests of forestry. It must be appreciated that the Reserve Forests are very important distribution areas for these species and that human activities, official and unofficial, in these areas are the main reason for their continuing decline. Their situation is precarious and this is primarily a function of the degradation of their habitat and the conservation of these species therefore depends on the conservation of their habitat.

It is therefore recommended that:—

1. In *Reserve Forests* certain areas known to support these species must be protected from total annual burning. This could be achieved in a number of ways depending on circumstances within each particular forest area, e.g.
   a) Those areas with natural firebreaks such as wet or dry watercourses, or small pockets of thatch-scrub surrounded by forest, should be left unburnt (which generally speaking they are not at the present time), e.g. the eastern side of Khalingdaur Reserve Forest and Naudaur/Balipara Reserve Forests respectively. This should cause no serious problem as there are no forestry operations in these areas apart from the domestic thatch requirements for forest

villagers and officials and these requirements should be met from elsewhere and access to these areas should be restricted, at least during the dry season. Burning for domestic thatch requirements by villagers and forest officials should be prohibited.

b) These Reserve Forests presently supporting populations of these species, but which are subject to total thatch-mahal, should have that mahal concession reduced to clearly defined areas and burning in these areas should be carefully controlled (which generally speaking is uncontrolled at the present time). This way areas could be set aside for these species that should be protected from incidental burning by fireline demarcation. Such areas would have to be at least three or four hundred hectares in extent in order to support viable resident populations. Such an area should be ecologically stable and it would be large enough to be less likely to be totally destroyed in the advent of accidental uncontrolled burning, and less susceptible to present hunting methods.

This may result in the loss of revenue by the reduction of the thatch concession, but these areas could be located where there are established plantations. Areas suitable for protection in this way are the eastern side of Darranga Reserve Forest, parts of Barnadi and Gohpur Reserve Forest (see later text also).

c) Additionally afforestation programmes could be subject to carefully controlled rotational burning so that mature plantations could support thatch-scrub that is left unburnt for several successive years. Early burning of such plantation in plots by demarcation could be rotated so that each plot was burnt not more than every 4 or 5 years so that there was always unburnt displacement habitat available in another adjacent plot.

d) In those Reserve Forests where total thatch-mahal concessions are of small value, e.g. Rowta and Subankhata Reserve Forests, this mahal could be abolished with only small loss of revenue. Such areas are more easily protected from burning and mahal encourages burning and unofficial access to Forest areas.

e) Better efforts should be made to control illegal burning in other areas where there are no mahal concessions and the 'fringe' practices of forest exploitation, e.g. grazing concessions, which represent an unjustifiable risk to habitat in terms of burning, hunting and other disturbances. These aspects should be considered when grazing or settlement rights are granted and preferably such rights should not be granted (or renewed) in areas where these species occur, e.g. Khalingdaur Reserve Forest.

2. In actual *declared wildlife areas* the extent of burning must be severely reduced.

a) At least one other area should be declared a Sanctuary, National Park or Wildlife Reserve for these species in view of the possible, if not probable, restriction to N.W. Assam and the fact that habitat protection measures are legally enforced only in those areas. Suitable areas would be Barnadi or Gohpur Reserve Forest (the latter would be easier to protect from accidental burning) as only these areas are definitely known to support both spe-

cies at the present time.

b) The level of burning must be reduced in Manas (and other Sanctuaries) and controlled burning should be undertaken only for firelines to prevent or reduce the extent of accidental burning. Access by tourists and labourers to some areas should be restricted during the dry season to reduce the risk of accidental burning.

It is felt that most, if not all of these recommendations, could be operated simultaneously as even if a conservation programme in any one area is successfully maintained for several successive years, a single chance fire could quite conceivably exterminate a small population by the total destruction of the available habitat. It is therefore necessary to maintain several populations in these different small areas in order to establish safety margins for the species survival. An additional safety margins for pigmy hog, i.e. captive breeding, must also be maintained and refined with the co-operation and information exchange of all organisations involved in the husbandry of these animals.

Summary

(1) This report is based on a three month field study of pigmy hog and hispid hare that was undertaken in N.W. Assam in March-June 1977. The survey was of admittedly short duration, but in the event its timing proved fortuitous as this dry season period is undoubtedly the most critical time for the biology and conservation of these species. The survey was sponsored by the Assam Valley Wildlife Society and the Wildlife Preservation Trust. I thad the full co-operation and support of the Assam Forest Department.

(2) Since the dramatised re-appearance of these supposedly extinct species in March 1971, there has been much interest in their conservation and there has been a concerted effort to maintain and breed the pigmy hog in captivity, though in retrospect this has not been successful in conservation terms, and anyway it is felt that captive breeding does not represent the solution to the conservation of these species which are much better protected in the wild state. However, the fundamental problems of the wild situation (which are resulting in the continuing decline of these species) have been poorly understood and an objective analysis of these factors has been urgently required.

(3) That these species are declining should be in no doubt as more and yet more of their thatch-scrub habitat is eroded and despoiled by encroachment, or dry season burning and other forestry practices. By the continuing process of settlement of an expanding and immigrating peoples, the natural thatch-scrub savannah habitat of these animals has been reduced to the Reserve Forest belt of N.W. Assam and the Manas Sanctuary. This habitat now forms a series of discrete isolated patches so that their population is subdivided into small units that are highly vulnerable to disturbance. The bulk of this population is in Reserve Forest and the remaining thatch-scrub in these areas is under tremendous exploitation pressure by thatch-mahal, afforestation and grazing. Moreover these areas (and the Manas Sanctuary) are almost universally subject to dry-season burning and burning has been shown to have an ecologically disastrous effect on the habitat of these animals. It is irrelevant whether this burning is the early controlled burning by forestry officials (for forestry purposes) or the later uncontrolled burning by other persons. Virtually all areas are burnt to a greater or lesser degree and these